REMARKS

Applicant respectfully requests reconsideration of the present application in view of the reasons that follow. The claims have not been amended in this response, but a detailed listing of all claims that are, or were, in the application, is presented, with appropriate defined status identifiers.

The undersigned would like to thank Examiner Garrett for the courteous interview of November 15th, and her understanding in view of the undersigned's travel difficulties. The present response focuses on points raised during the interview.

Claims 1-4 are rejected under the first paragraph of Section 112. The examiner urges that the claims contain subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventors had possession of the claimed invention at the time of filing. She notes that the phrase "at least two" is considered to be new matter (although she does not cite Section 132 of the statute), and comments that "it is not seen where the specification provides for an unlimited number of light-emitting layers, which the claim language 'at least two' would include" (emphasis in original). However, a claim reciting "at least two" light-emitting layers must be read in the context of the level of knowledge in the relevant art in order to determine whether it conveys to one skilled in that art that the inventors had possession of the claimed invention at the time of filing. It cannot be read in a vacuum. Commonly, white-light emitting OLED devices include three layers. See, for example, appended online excerpts described white-light emitting devices with three emission layers. The present specification, on the other hand, provides examples in which two layers are used to produce a white-light emitting OLED. Taken in the context of the level of knowledge in the relevant art, the claim fully conveys possession of the presently-claimed scope of the invention, in which there are at least two light-emitting layers in a white light emitting device.

Claims 1, 5, 13, and 17-19 are rejected under Section 103(a) based on Codama (US 6,091,196), and claims 2-4, 6-8 and 20 are rejected under Section 103(a) based on Codama in view of Toguchi *et al.* (US 6,753,097). The examiner maintains that "Codama generally teaches that perylene derivatives are materials that may be used as the fluorescent substance of the device...Codama is deemed to teach fluorescent material in the light emitting layer within the range disclosed by applicant" (citing col. 16, lines 38-41 of Codama).

It is true that Codama teaches that "perylene derivatives are materials that may be used as the ***fluorescent substance of the device,***" just as the examiner states. However, the present claims do not use perylene derivatives as the "fluorescent substance." To the contrary, the present claims clearly recite "a stabilizing substituted perylene material ***having a concentration selected so that it does not emit light*** to thereby increase the lifetime of the white-light-emitting OLED device." The claims thus clearly distinguish over any reference which teaches the use of perylene derivatives as the ***fluorescent*** substance.

The examiner cites column 16 of Codama as disclosing "fluorescent material in the light emitting layer within the range disclosed by applicant." However, the cited portion of Codama relates to the amount of rubrene, a different yellow-emitting dopant, in an emissive layer. The amount of dopant that must be added to a layer in order for that layer to emit light differs for ***each*** compound. Therefore, it is improper to assert that a teaching of the amount of rubrene to be added to a layer in order to make that layer emit light "teaches" the amount of a perylene derivative that must be added in order to make a layer produce light. Indeed, applicant's specification notes that "it is necessary that the level of dibenzoperylene concentration be selected so that the dibenzoperylene is a non-luminescent dopant. The level at which this occurs will ***vary*** depending on the properties of the layer" (paragraph bridging pages 27 and 28). For example, for the particular compound used in examples 1-6, amounts of less than 5% must be used to prevent luminescence. By contrast, for the compound in examples 13-18, it is reported that higher amounts can be used, up to 10%. This confirms that the amount of a substance necessary for luminescence is dependent on the particular compound, and negates the value of Codama's teaching with respect to what amount of rubrene will produce a light-emitting layer. Thus, Codama does not teach an amount of a perylene derivative "within the range disclosed by applicant," because applicant's range recites an amount that ***"does not emit light."***

While at the interview, Examiner Garrett showed the undersigned US 5,601,903, which she had recently discovered. This invention seeks to reduce the amount of accumulated carriers at the boundary between an organic luminous layer and an organic carrier transport layer, which causes a loss of luminosity with time, and/or to curb degradation due to heat. In order to achieve the object of the invention, an organic electroluminescent element is characterized in that either the organic luminous layer or the organic carrier transport layer, whichever is placed closer to the hole injecting electrode, is doped with a first organic material, the first organic material being made of at least one

substance, a minimum level of a conducting band of the first organic material being lower than a minimum level of a conducting band of a material forming the layer to be doped with the first organic material, and the other layer which is placed closer to the electron injecting electrode is doped with a second organic material, the second organic material being made of at least one substance, a maximum level of a valence band of the second organic material being higher than a maximum level of a valence band of the other layer to be doped with the second organic material. Both the first organic material and the second organic material are selected from a group consisting of rubrene, tris(8-hydroxyquinoline)aluminum, 4-(dicyanomethylene)-2-methyl-6-(4-dimethylamino-styryl)-4H-pyran, decacyclene, 1-ethyl-2-[(1-ethyl-2(1H)-quinolylidene)methyl]-quinolinium iodide, naphthacene, or 9,10-diphenylanthracene, which are expressed as Chemical Formulas 101, 102, 103, 104, 105, 106, and 107, respectively. Thus, the compounds are selected based on their valence band relative to the material into which they are doped. See column 2, lines 16-64, for example. It is important to note that none of these compounds are perylene derivatives. Moreover, there is no teaching that luminescent dopants in general stabilize an OLED.

During the interview it was discussed whether applicant is attempting to distinguish their product claims over the art by asserting an unappreciated result of perylene derivatives. The issue in the present case is one of obviousness, not anticipation. Consideration of an inherent quality is relevant only to anticipation, not obviousness. *Jones v. Hardy,* 230 USPQ 1021, 1025 (Fed. Cir. 1984). *Jones* dealt with the issue of whether the discovery of a use of an inherent quality of a product well known in the art was unpatentable because of obviousness. The claims at issue were directed to a polystyrene mold having a pattern of artistic relief and a method of constructing a concrete wall using the mold. In the prior art, polystyrene was used for simple molds while other materials were used for making designs. The other materials used for designs presented problems of releasability. Since the claims were directed to molds with designs, there was no anticipation. The court found that the property of releasability that was inherent in the prior art use of polystyrene in simple molds was not relevant to a determination of obviousness. In finding the invention nonobvious, the court noted that consideration must be given to the invention as a whole, not the "degree of inventiveness."

Similarly, the claims here are directed to amounts of perylene derivatives in "a concentration selected so that it ***does not emit light,***" as opposed to amounts of perylene derivatives that will serve as the fluorescent substance in a layer (*cf.* molds with designs as opposed to molds without

designs in *Jones*). The claims thus are not anticipated by prior art disclosures, such as Codama, which discloses perylene derivatives used as the ***luminescent*** material in a layer, *i.e.*, in a concentration selected so that it ***does emit light***. The doctrine of unappreciated features or results only comes into play if the amount of perylene derivative is such that it is anticipated by the prior art. In that case, applicant would be seeking to patent a product that has already been disclosed. That is not the case here.

Toguchi *et al.* is cited for its teaching of the specific perylene derivatives recited in claims 2-4, 6-8 and 20, and does not overcome the failure of Codama to suggest amounts of perylene derivatives that do not emit light. The combination of Codama and Toguchi therefore does not undermine the arguments presented above.

Applicant believes that the present application is now in condition for allowance. Favorable reconsideration of the application as amended is respectfully requested. The Examiner is invited to contact the undersigned by telephone if it is felt that a telephone interview would advance the prosecution of the present application.

If there are any problems with this response, Applicant's attorney would appreciate a telephone call. In view of the foregoing, it is believed none of the references, taken singly or in combination, disclose the claimed invention. Accordingly, this application is believed to be in condition for allowance, the notice of which is respectfully requested.

Respectfully submitted,

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the electron transport and hole transport layer. In white-color emitting devices there may be three separate emission layers, each emitting a different color. So today's devices may have a total of 7 - 9 layers - including electrodes, deposited by different techniques (sputtering, vapor deposition, solvent coating, etc). In spite of the large number of layers the total thickness of the device is typically less than 100 - 200 nm.

The deposition of all layers requires humidity- and oxygen-free conditions and all will require class 10 clean room. The cost consequence of such complexity is high. The deposition of each layer negatively impacts the manufacturing yield of the final device. The number of layers depends primarily on the type of materials used. It is still not clear how many layers will be ultimately needed to achieve the best performance.

Polymeric OLED devices

Polymeric OLED devices have usually fewer layers. The electroactive polymers may serve multiple functions: both electron and hole transport and light emission, even though dopant emitters can be used to tune the color. The electron transporting polymer and hole transporting polymer may be in one or two separate layers. In some cases, very thin layers of p-doped and n-doped semi-conducting polymers are sandwiched between the transport polymers and the cathode and anode, respectively, to facilitate charge injection. The active polymers and the injection layers are solution-coatable, but the electrodes are deposited by different techniques such as vapor deposition or ion sputtering, as in "small molecular" devices. To date, a large number of polymers have been synthesized and tested, and new structures are still emerging. The polymers have an extended chain of conjugated double bonds or aromatic rings, and pendant groups, which determine the emission characteristics. The polymers are members of the polyphenylene vinylene family, polyfluorene homo- and copolymers and a new class of poly-spiro emitters *(13)*.

"Small Molecular" OLED Devices

As the name indicates, the active components are "small" molecules. These small molecules are deposited by vapor deposition. Most "small molecules" would crystallize when deposited from solutions and crystallization would damage the device performance. Also, solution coating may result in uncontrollable mixing of layers. Most of the hole-transport small molecules contain one or several aromatic amine groups (a key pre-requisite for hole transport) and a variety of pendant substituents. These molecules have a low oxidation potential and must form stable cation-radicals.

Electron transport molecules are typically complexes of a metal such as aluminum (such as Alq_3), boron, etc. with aromatic groups, bis-biphenyl anthracene, or, recently developed silacyclo-pentadienes *(14, 15)*. These molecules have a relatively high electron affinity and must form stable anion-radicals. Some silacyclo-pentadiene may be unstable but new structures are being synthesized. The detailed description of the structures of charge transport materials is beyond the scope of this overview.

Also, there is a need to fabricate the devices with extremely uniform thicknesses of each layer. Nonuniformities may lead to localized surges of electric current, localized overheating, and gradual destruction of the device. The complexity makes the fabrication of OLEDs difficult and slows down testing of new materials.

Article

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ORGANIC WHITE LIGHT EMITTING DEVICES WITH AN RGB STACKED MULTILAYER STRUCTURE

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Abstract:

White organic light emitting devices (OLEDs) with an RGB stacked multilayer structure are demonstrated. In RGB staked OLEDs, blue emitting 1,4-bis[2,2-diphenylvinyl]biphenyl (DPVBi), green emitting quinacridone (QD), and red emitting [2,6-bis[2-[5-(dibutylamino)phenyl] vinyl]-4H-pyran-4-ylidene]propanedinitrile (DADB) were used. Through the optimization of the device structure, the pure white light emission with CIE coordinates of (0.33,0.33) at 20 mA/cm^2 was obtained, at which the color temperature and color rendering index were 5560 K and 79, respectively. Its maximum luminance was 14,000 cd/m^2 at 12.6 V, and the luminance efficiency was 1.34 lm/W at 100 cd/m^2.

Small Molecule

The earliest OLEDs work was done at **Eastman Kodak labs** by Ching Wan Tang and Steven Van Slyke.; and almost all OLED patents issued since refer to them. In 1982 they obtained electroluminescence from (hydroxyquinoline aluminum) AlQ3. The early simple 2 layer device gave a luminance of 1000 cd/m2 at 10 Vs. Later the display was improved greatly by doping the emitter layer with small amounts of fluorescent laser dyes, and used to change colors. For white light, more emission layers were added, each specifically (color) dyed (the shades determined by the thickness of the layer,) a first step toward hi-efficiency devices.

"Doping the emissive layer with highly fluorescent molecules...is critical for producing color OLEDs," says a Kodak paper. (In an experiment to test toxicity - a hot topic for dyes – Arthur Schalow, one of the laser inventors, injected fluorescein dye in jello, which he lased, and then ate -living for many more years.)

Kodak sells the indispensable organic supplies to its licensees (red, green, blue emitters, NPB- a hole transport material, Alq – the electron transport and hole injection layer, dyes and laser dyes.)